Wireless rObust Link for urban Force operations

WOLF project keynotes
IST092 - September 2010

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Presentation agenda

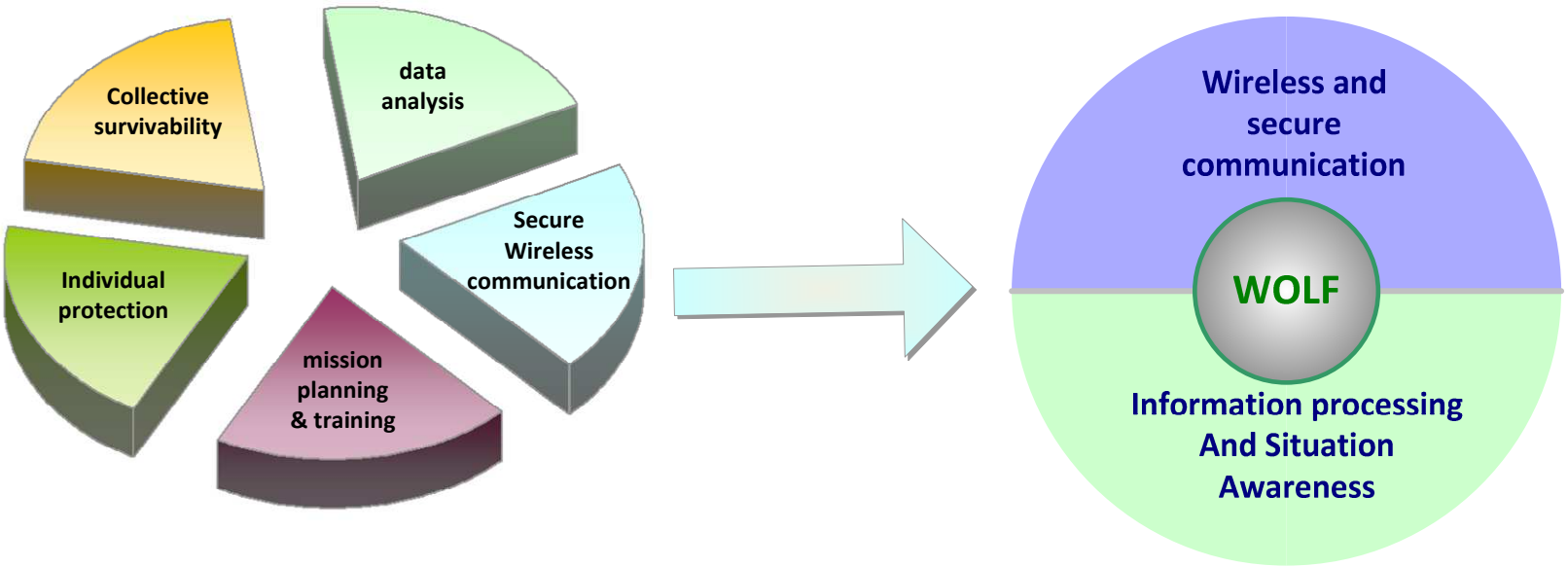
- Framework and motivations
- Aimed capabilities and roadmap
- Project organization
- Technical highlights
- Conclusion

Framework → Joint Investment Programme on Force Protection

R&T Joint Investment Programme on Force Protection (JIP-FP)

- ❑ Launched by the European Defence Agency at the end of 2006
- ❑ 3-year programme
- ❑ Total € 54.9 million
- ❑ 20 European governments
- ❑ Promotion of partnership and networking among the European defence R&T stakeholders

R&T priorities



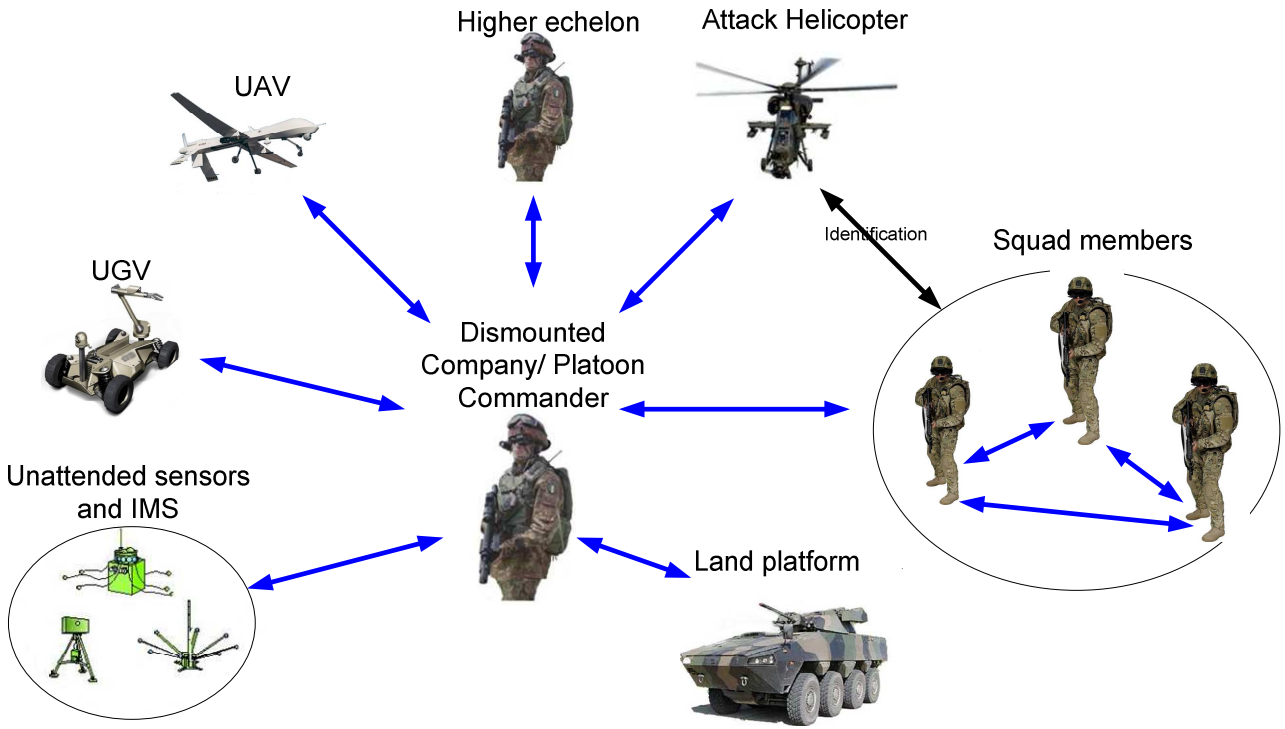
Framework → MOUT : current situation

Military Operations in Urban Terrain

- Complex situation due to urban environment : civilians, ambushes → need for awareness
- Command and Control are difficult
- Combats usually at squad level with low coordination with higher echelons
- Communication failures (indoors, urban canyons) with actual soldier radios

Dismounted soldier should not be isolated

Provide dismounted soldier with efficient communication system

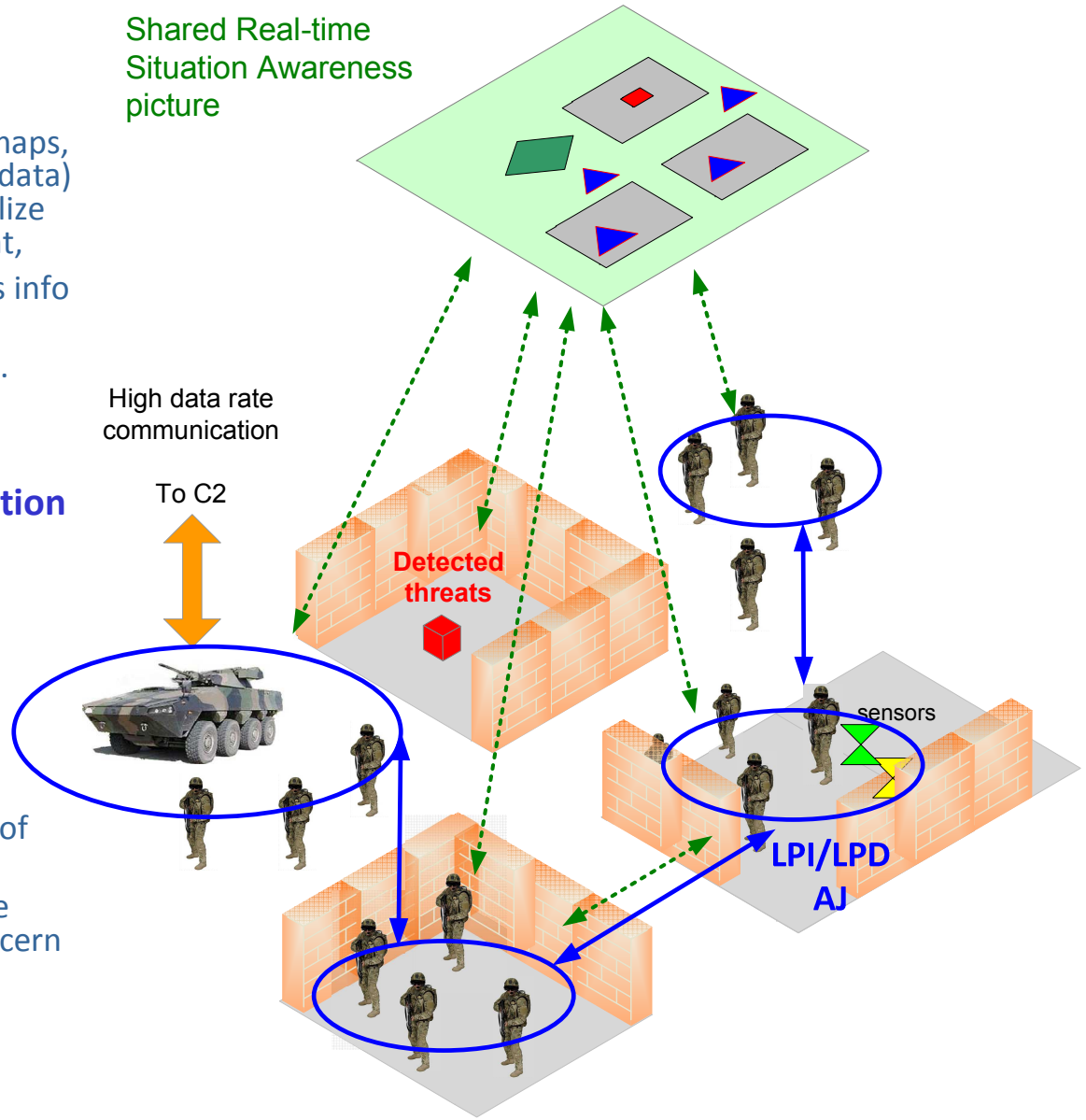


Information processing & situation awareness

- Transmission of digitized information (maps, photo, videos, tracking and positioning data) that will permit to soldier squads to realize progression in an unknown environment,
- Exchange of shared situation awareness info between vehicular and soldier nodes.
- Connection with Command and Control.

Wireless secured & robust communication

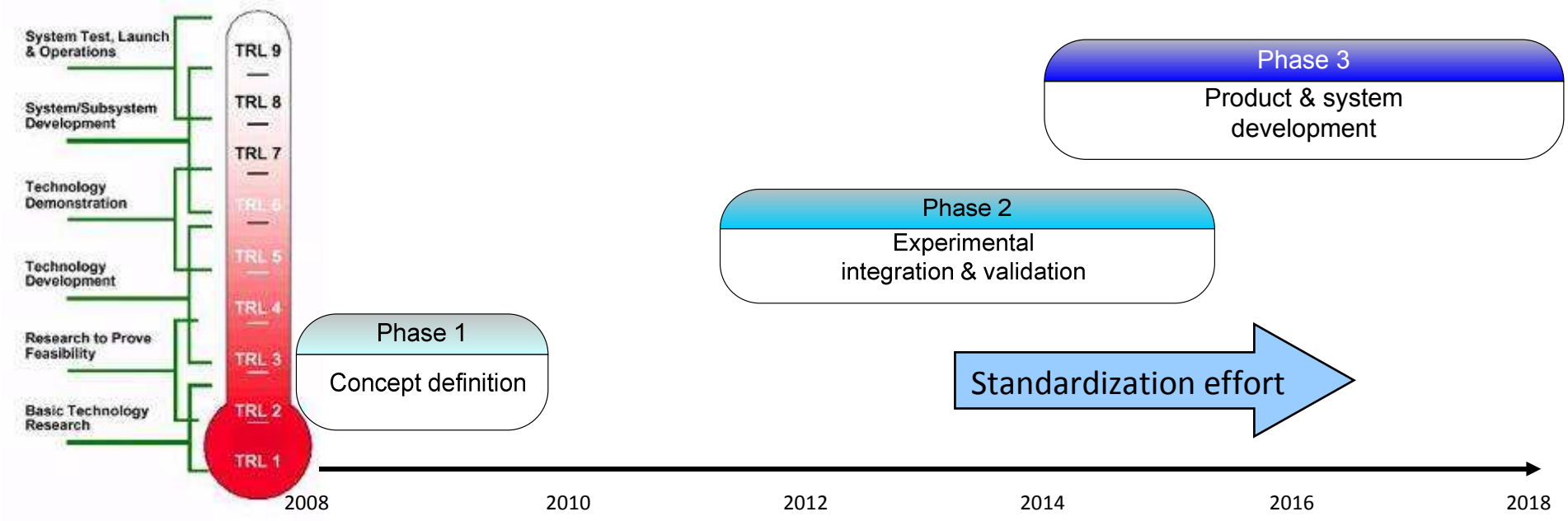
- Based on MANET for connectivity
- Specific urban constraints :
  - physical characteristics of the building constructions,
  - Specific propagation environment
- Possible jamming or limited availability of frequencies,
- Various countries, and situations, where frequency regulation may not be of concern



WOLF rodmap in 3 phases

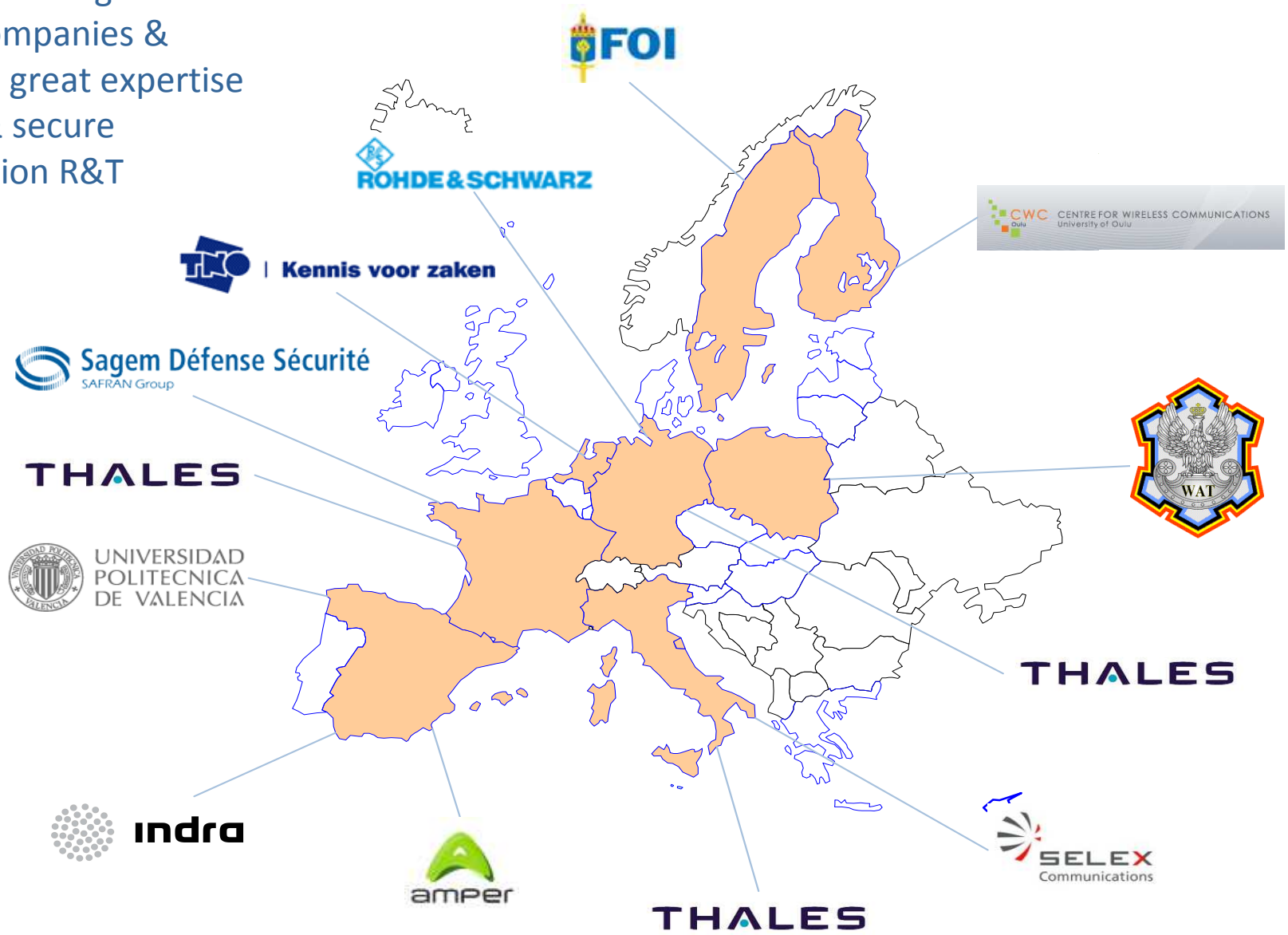
Phase 1 (current contract) : concept definition

- ❑ Define the requirements
- ❑ Define the system architecture
- ❑ Study and evaluate different possible technical solutions
- ❑ Identify the best suited techniques with unitary simulations based on relevant scenarios
- ❑ Propose and promote an harmonized scheme for the future system

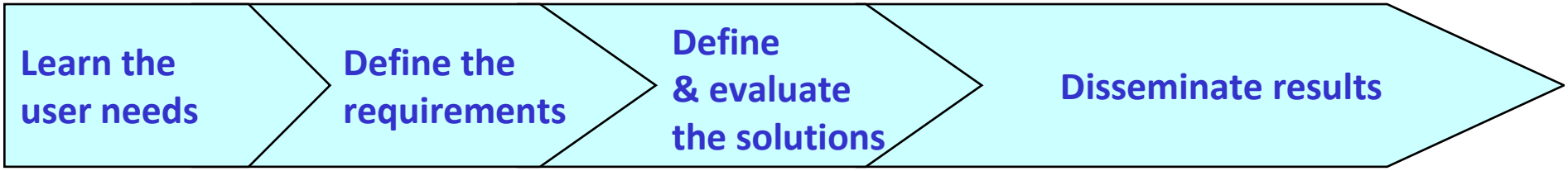


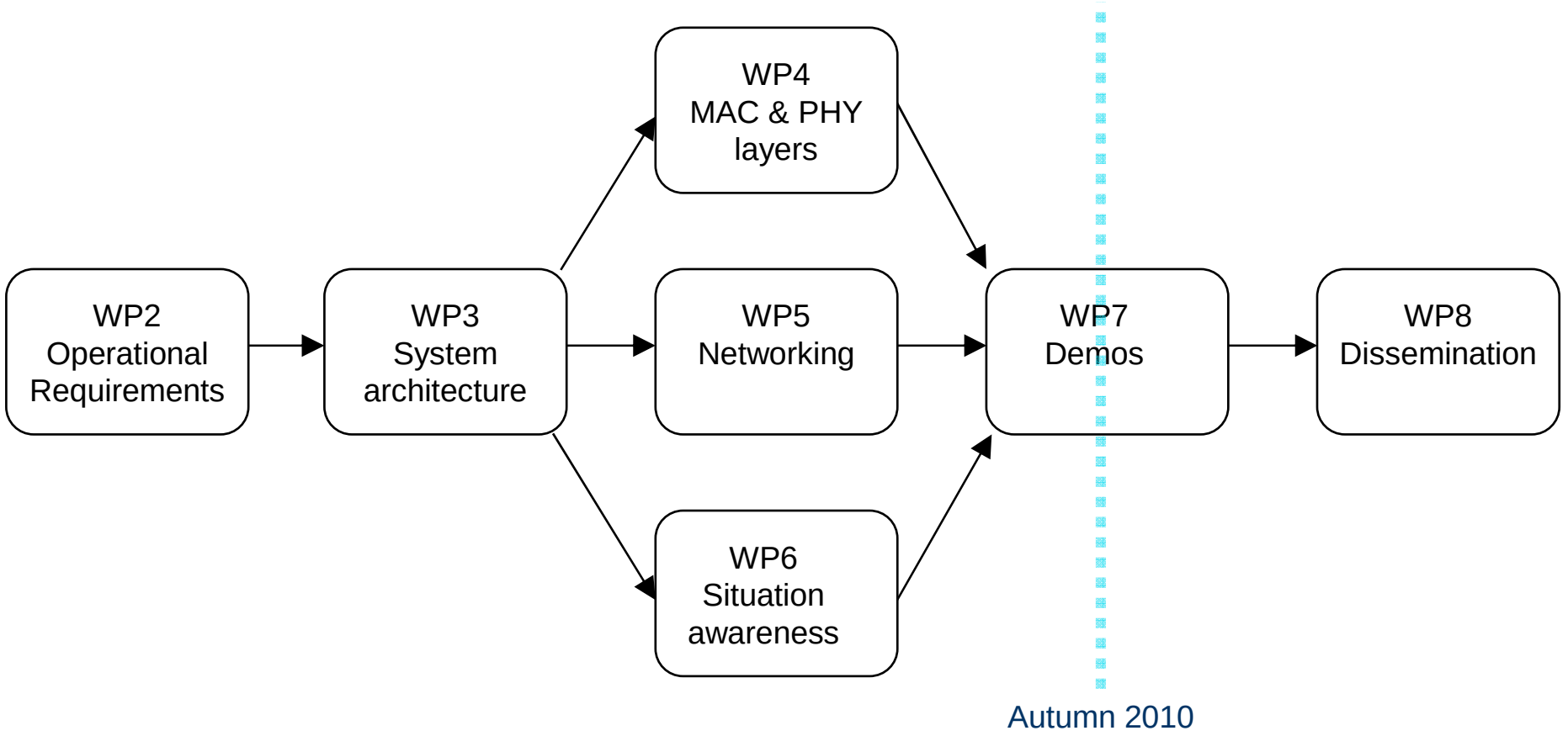
Project organization → partnership

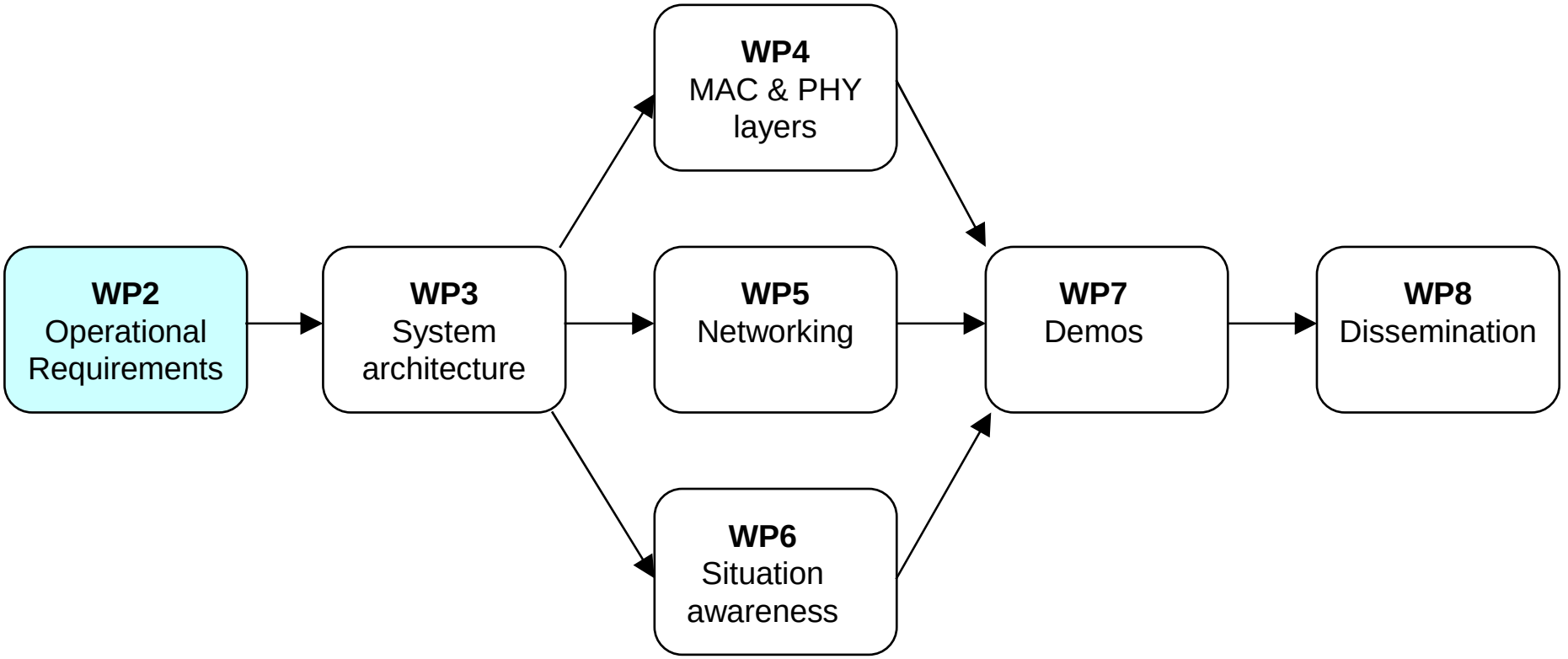
WOLF consortium gathers European companies & entities with great expertise in defense & secure communication R&T



Project organization → tasks



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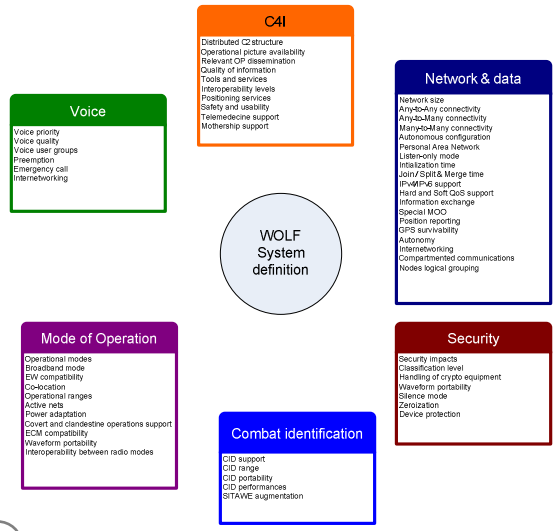
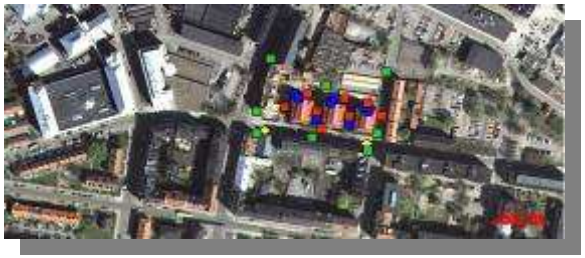
Dissemination

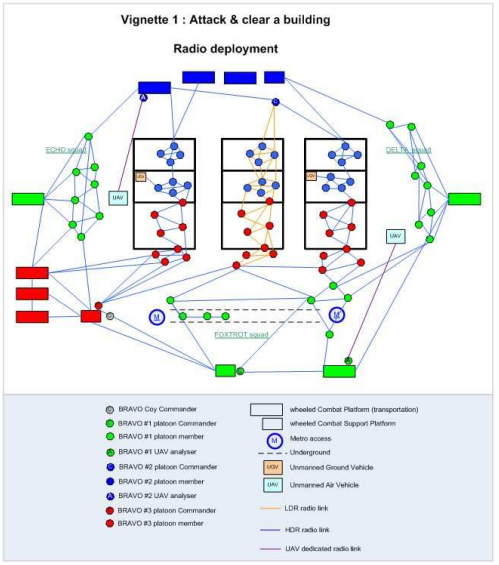
Analysis of end-user requirements in terms of secured tactical wireless communication in urban environment

- Perform end user interviews to refine operational needs
- Develop scenarios to identify the framework of the project
- Derive requirements from the soldier's point of view (NATO Architecture Framework)
- Tune the project to focus on technical aspects derived from user requirements



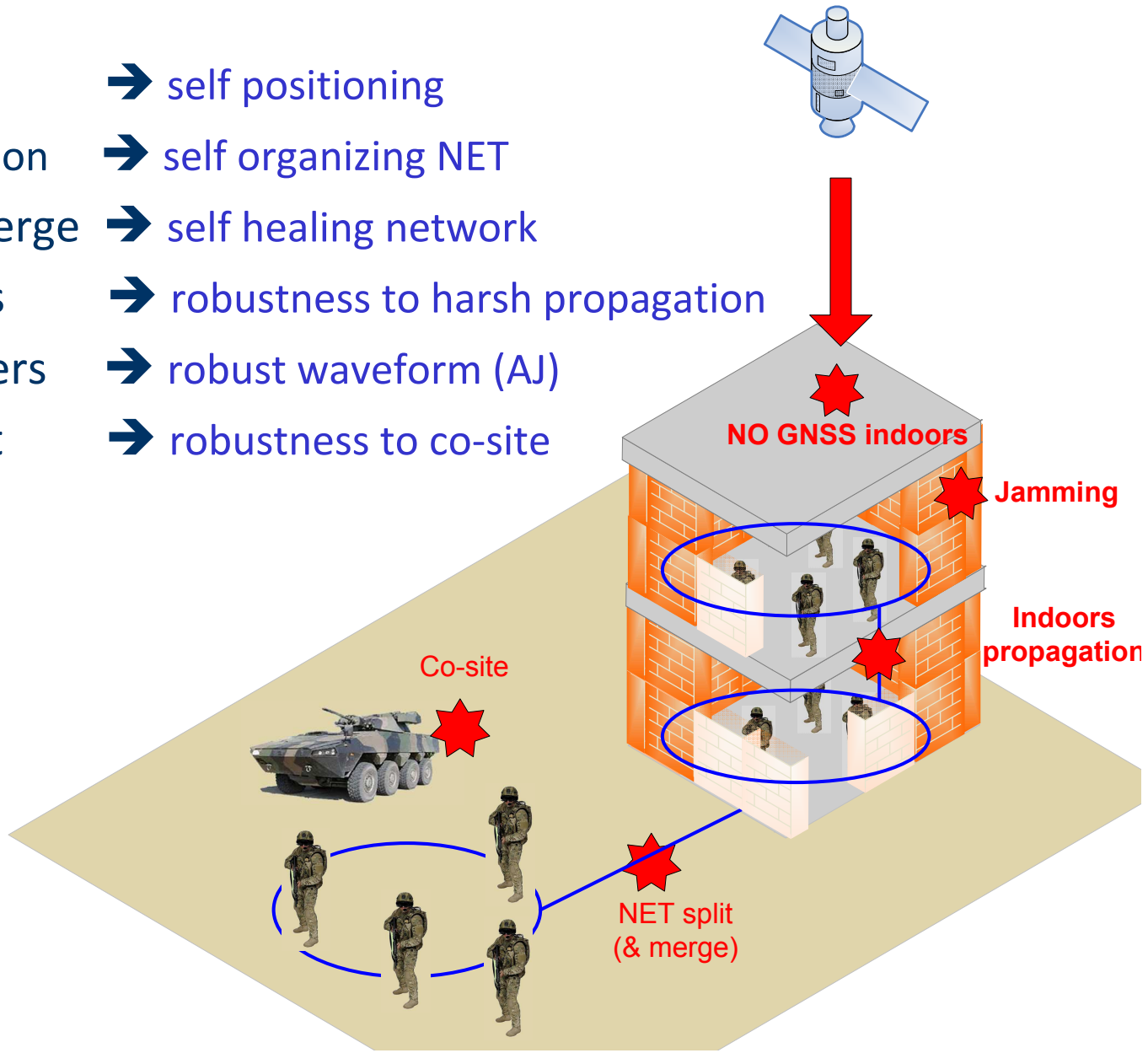
✓High density
✓Indoor, indoor/outdoor and underground comm.
✓Need of non-hierarchic communication
✓Need for accurate positioning information
✓Need for image transfer
✓Risk for jamming



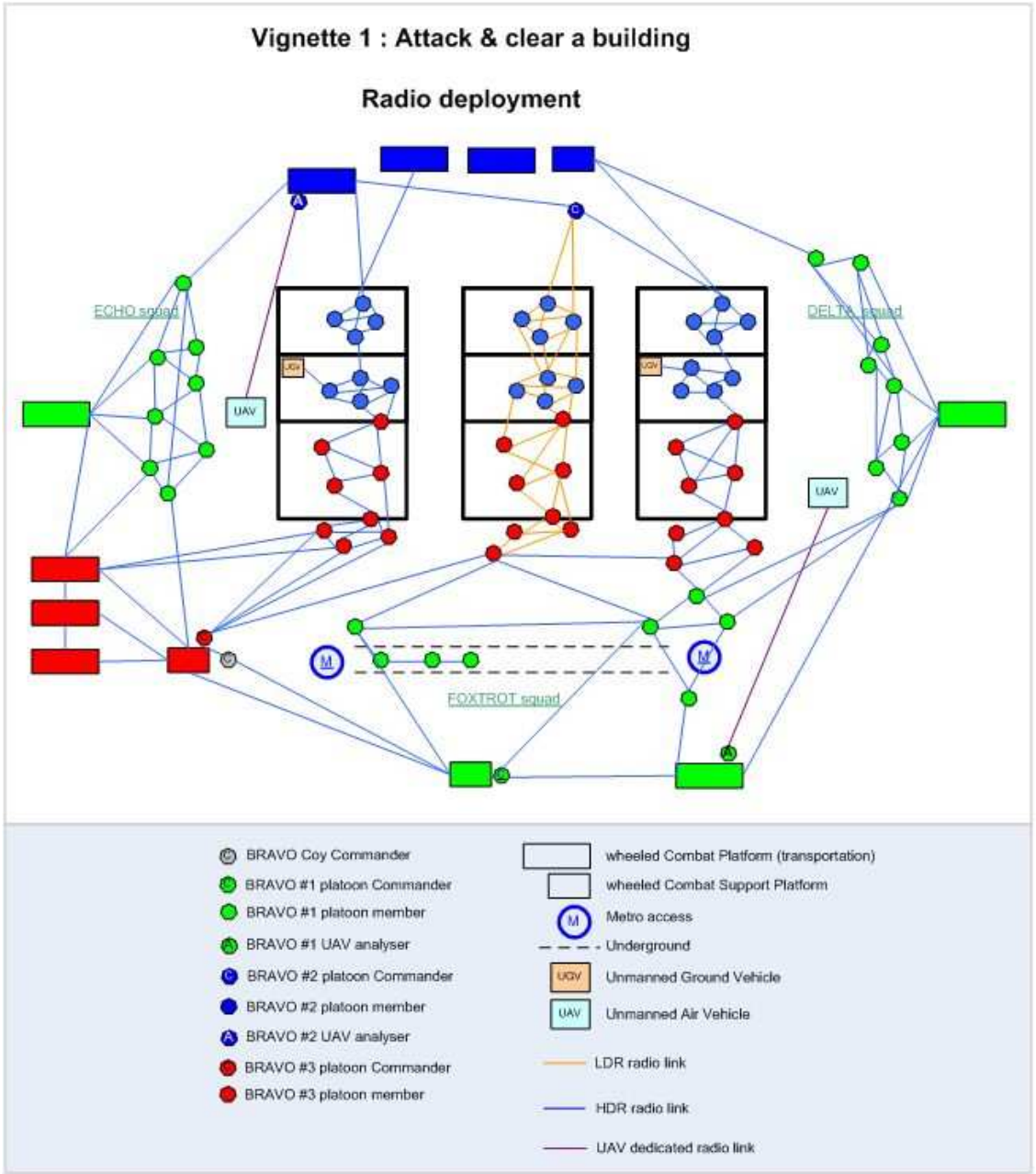


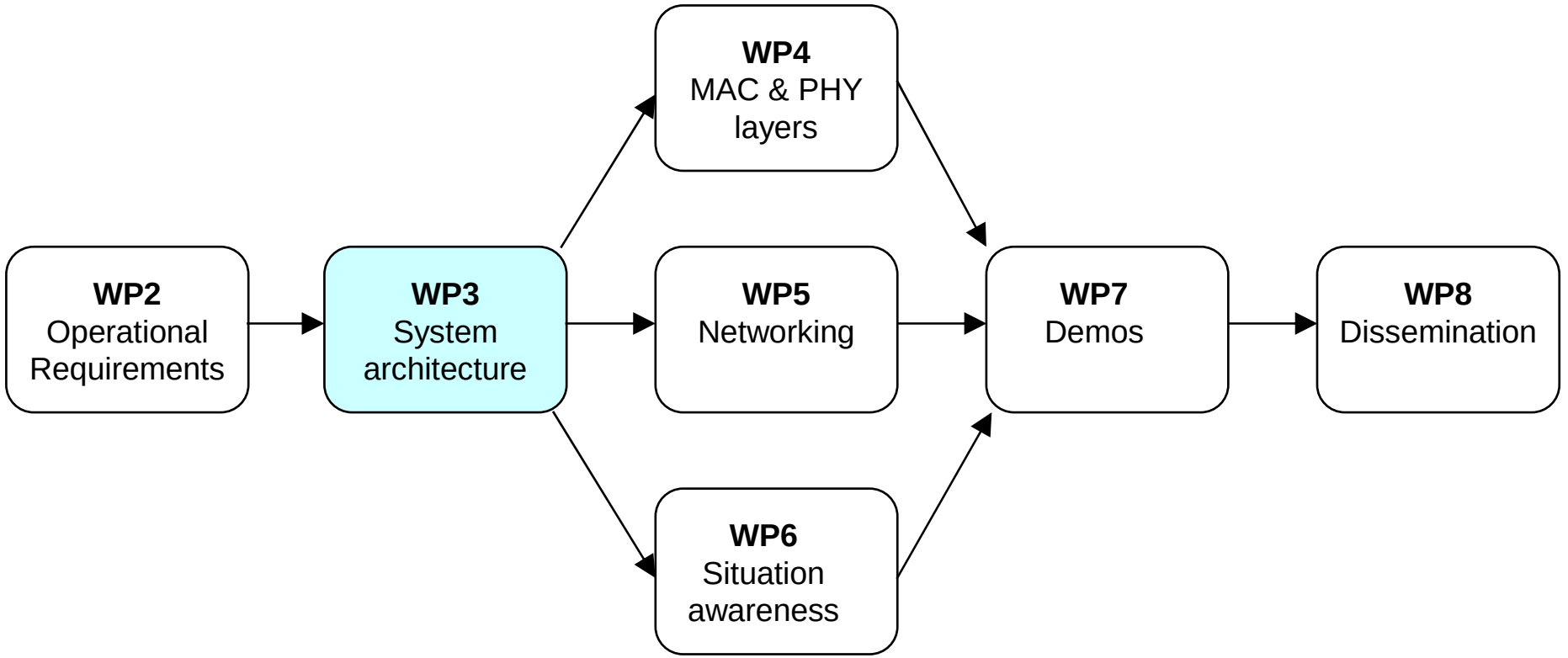
Technical insights → Operational capabilities : specific MOUT

- GNSS survivability
  - Positioning → self positioning
  - NET synchronization → self organizing NET
- Network split & merge → self healing network
- Indoors operations → robustness to harsh propagation
- Presence of jammers → robust waveform (AJ)
- Dense deployment → robustness to co-site



Technical insights → Operational Requirements

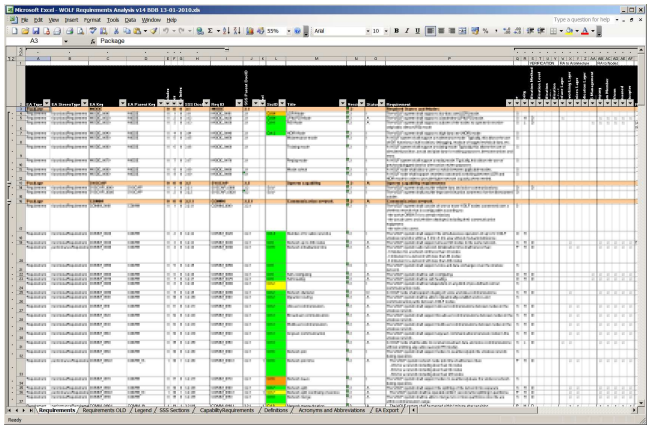


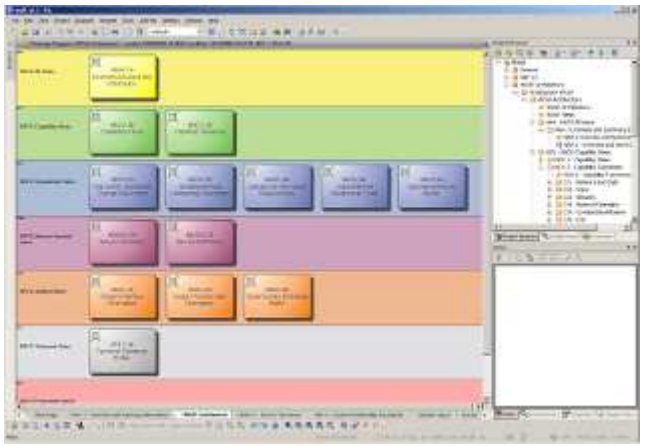


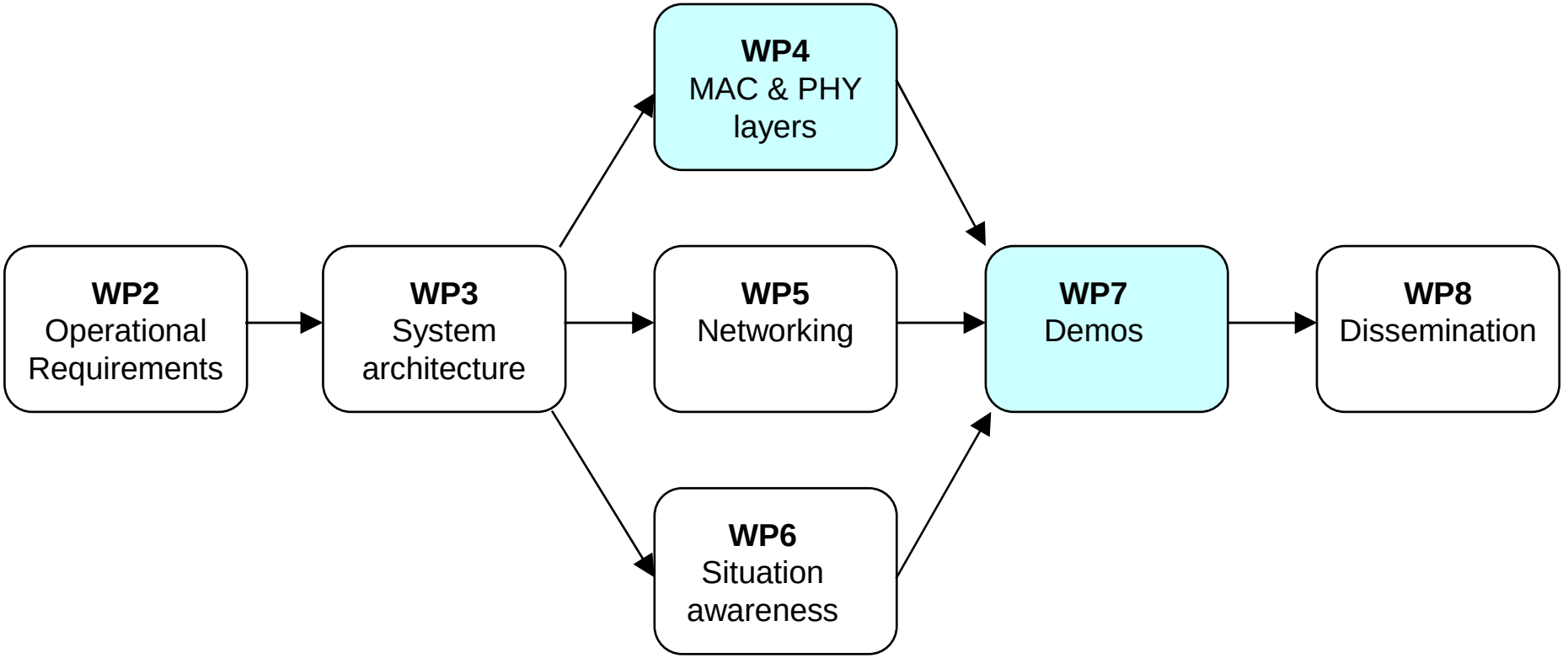
Objective : Define the general system architecture for the WOLF system, from operational requirements

Technical insights → System Architecture

- System requirements defined
- Architecture utilizes concept of civil standards
  - Cross-layer management from Communications Access for Land Mobiles (CALM)
  - QoS aspects from IP and IEEE 802.11
- Use of NAF V3 for Architecture description
- Application oriented architecture concept
  - Different modes of operation share the same basic set of interoperable services



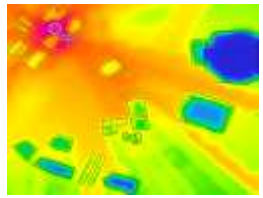




Objective: specify and evaluate candidate schemes for MAC and physical layers, suitable for MOUT context

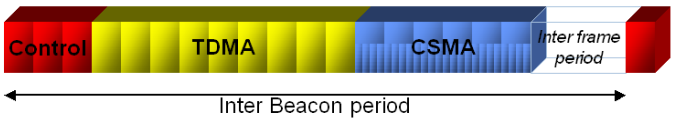
Technical insights →MAC & PHY layers

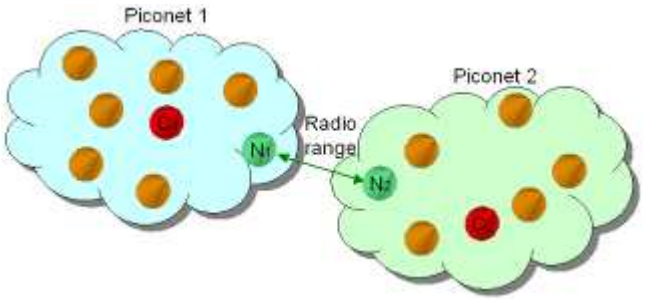
- Identified frequency bands
  - V/UHF [200-400] MHz : propagation / crowded spectrum → Low data rate
  - L band [1.3-1.7] GHz : short range / bandwidth → High data rate

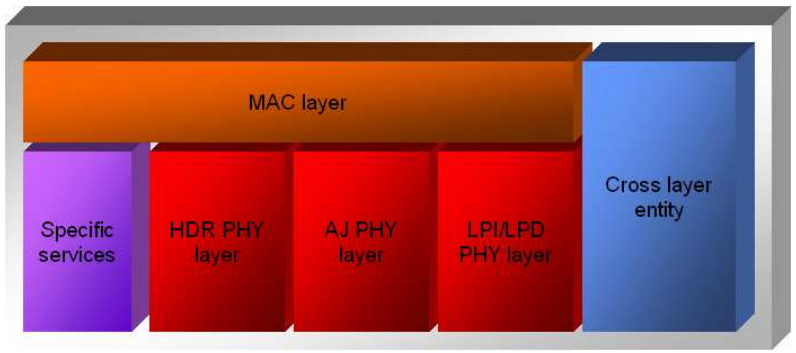


- Propagation analysis provides models for
  - Simulations of urban propagation
  - Future tool for propagation prediction (range estimation)

- Proposal for a MAC layer
  - Management for interoperability of the PHY modes
  - Ensuring QoS continuity → TDMA, queuing mechanisms
  - Adaptation to operational needs (Split & Merge)
  - Clusterized network
  - Cross-layer mechanisms (relaying, link status, QoS,…)

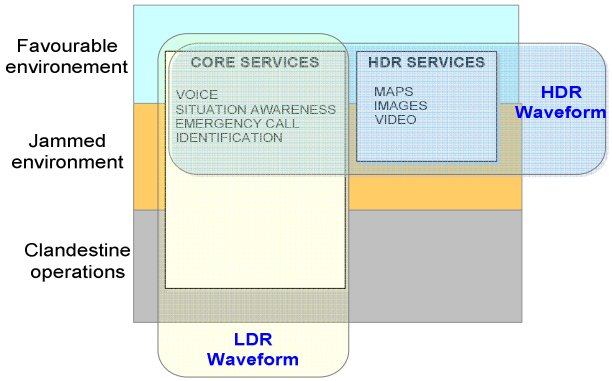




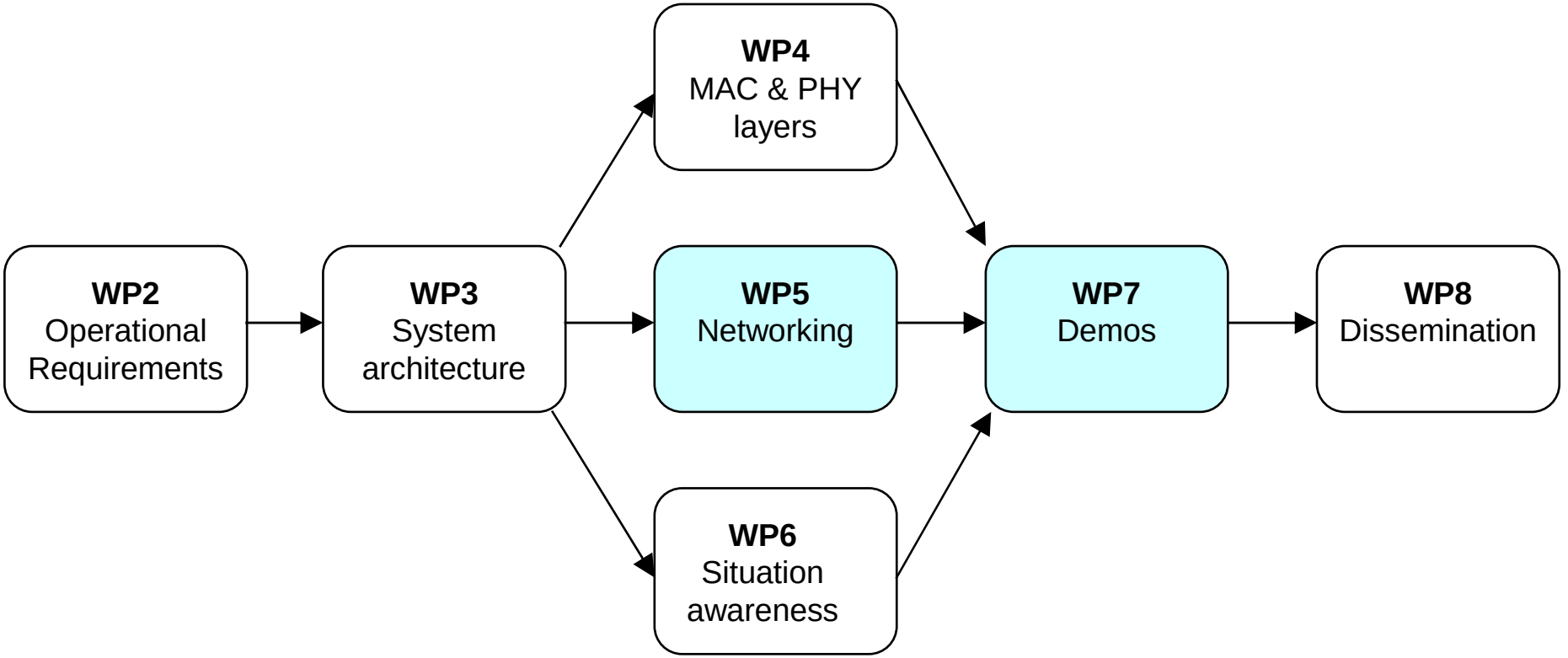


Technical insights →MAC & PHY layers

- Candidates for PHY layer
  - LDR waveform ➔ max. range + LPI/LPD or AJ properties
    - Low data rate mode (in a 25kHz bandwidth for FH, 5MHz for DS),
    - Medium data rate mode (in a 100kHz and 250kHz bandwidth for FH, 5MHz for DS)
    - Emergency call mode (maximum robustness and elongation), but no MANET support.
  - HDR waveform ➔ high throughput
    - FH into 1.25MHz or 5 MHz
    - Multi carriers (OFDM/A, FFH-OFDM, MC-SS), single carriers (CPM) or SC-FDMA



  - Candidates are being **evaluated** and **selected** through **simulations** (2010):
    - Robustness of LPI/LPD and AJ waveforms ?
    - Performance and robustness to multipath of HDR waveforms (synchronization) ?
  - Demo in Thales Communication, France, October 2010

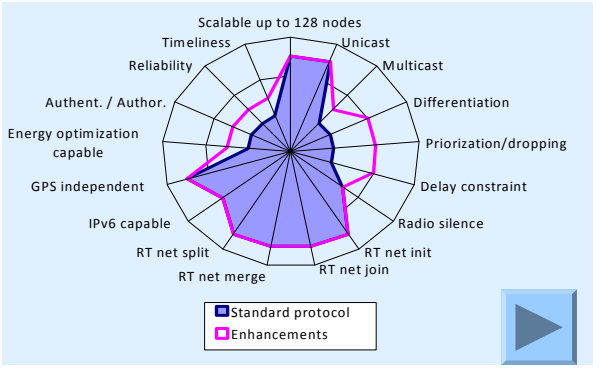


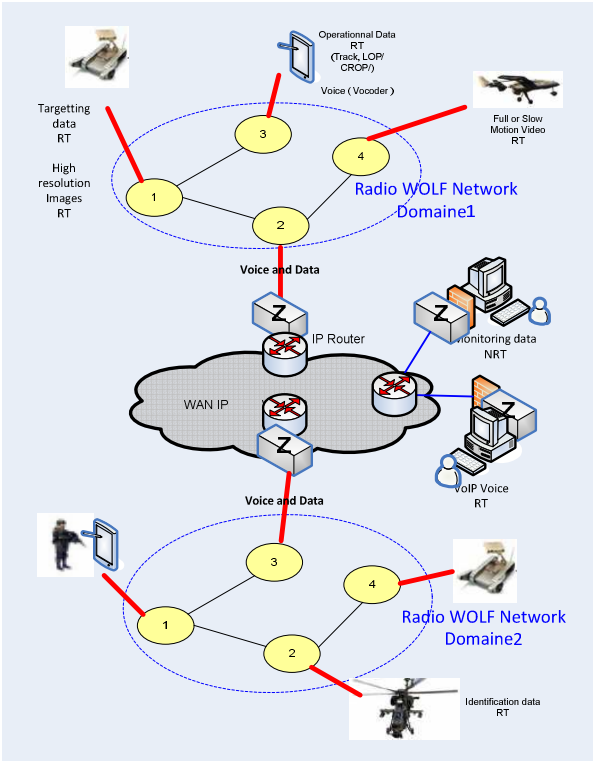
Objective: define network topology, strategies & mechanisms (addressing, routing) suitable for MOUT and in collaboration with MAC

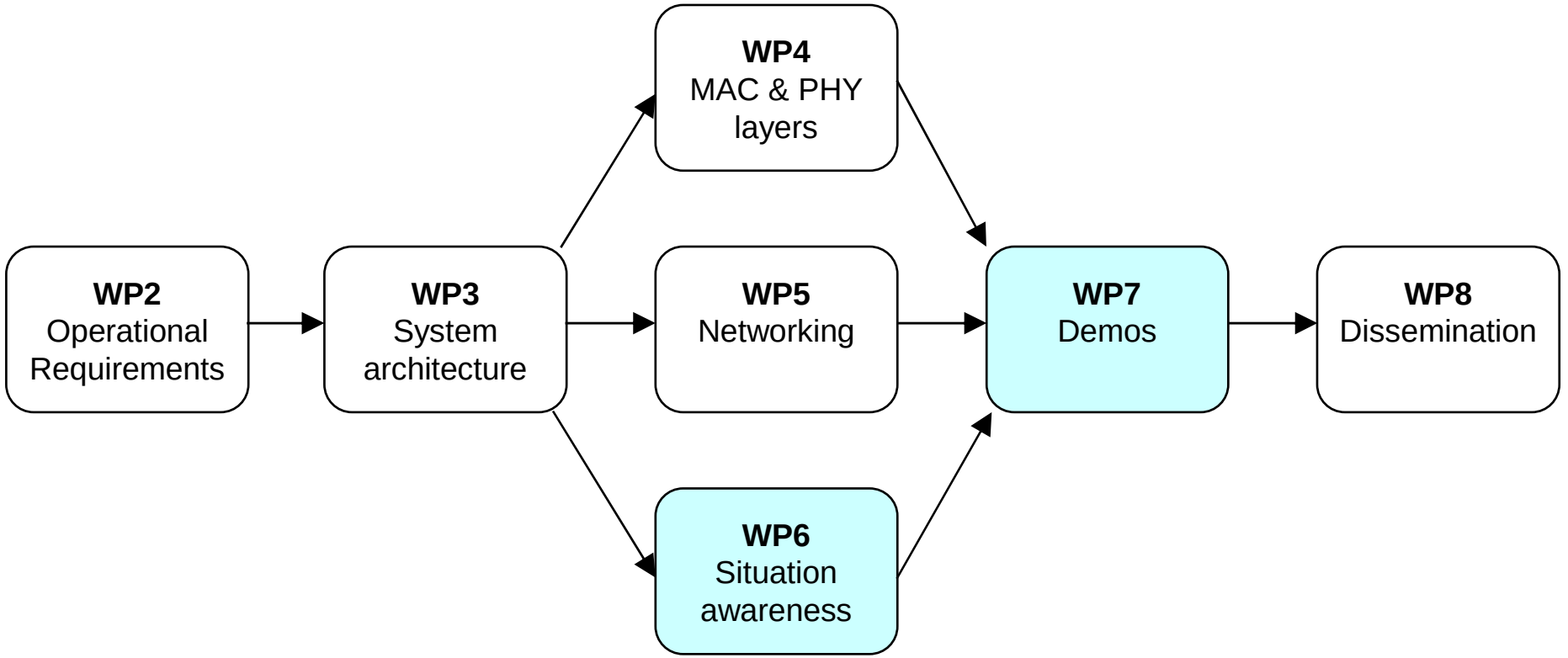
Technical insights → NET layer specification

- Ad Hoc Networking guarantees survivability of WOLF communication
- Best capabilities coverage with AODV, DYMO and OLSR
- Focus on OLSR
- Main functionalities
  - Unicast routing considering several metrics (multi route computation)
  - Multicast routing (predefined and dynamic multicast groups)
  - Soft QoS routing (differentiation)
  - Hard QoS routing (reservation)
  - External connectivity based on Mobile IPv6
- definition of the Wolf Adaptation Layer (WAL) for efficient cross-layering with the MAC
- Demo in SAGEM, France, October 2010

OLSR – TRL analysis



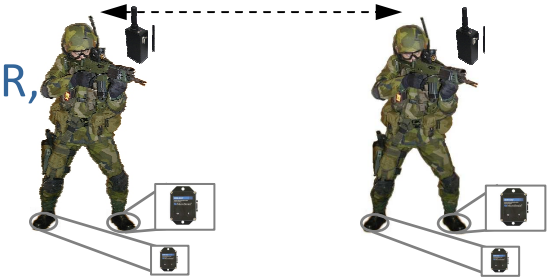


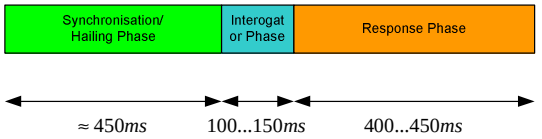


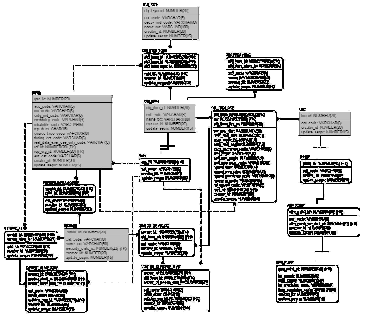
Objective: Identify suitable techniques for SA, and define the SA mechanisms (data model, aggregation, dissemination)

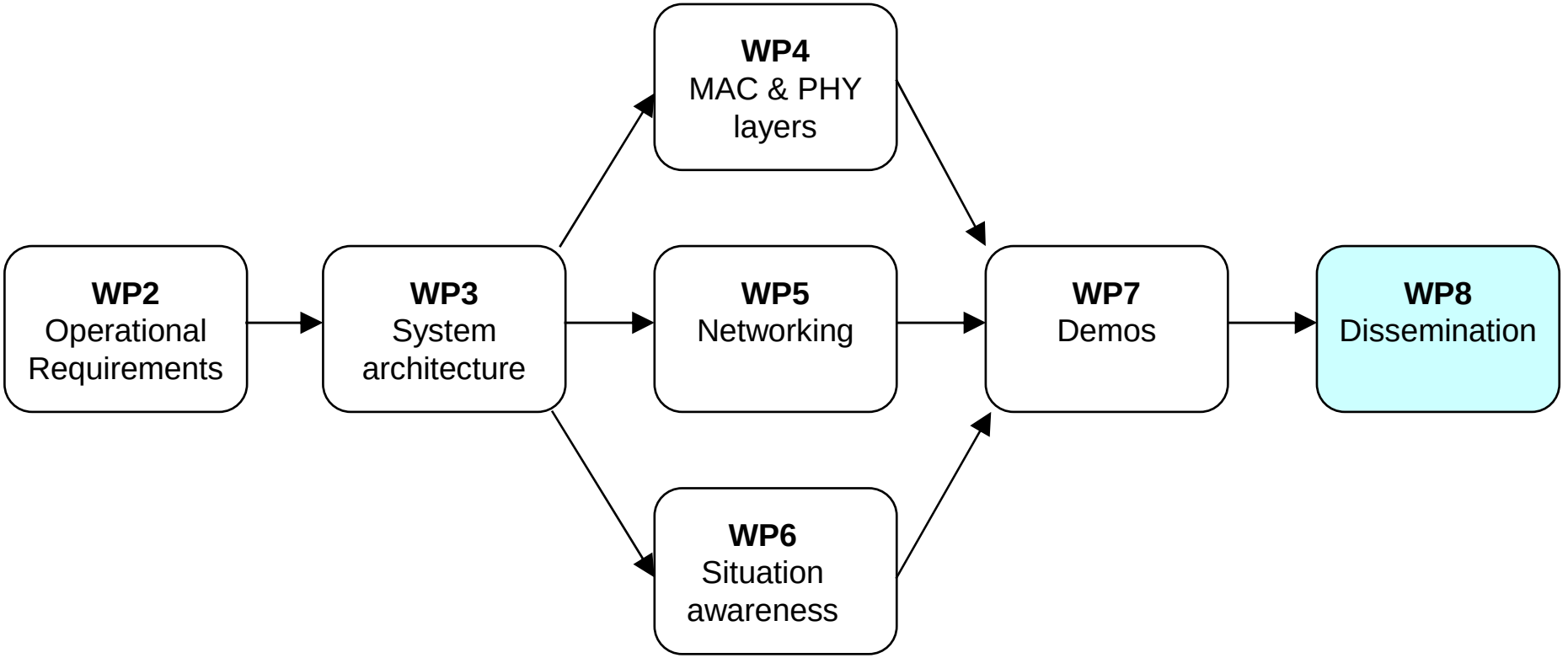
Technical insights → Situation Awareness

- Robust sensor fusion
  - Use cases evaluation: sniper detection, close combat, CSAR, evacuation of hostages
  - Intelligent sensor management is needed
  - Goal : virtual distributed cognitive sensor system
- Proposal for TDCSA
- Positioning techniques
  - combination of GNSS, inertial, RF-positioning techniques
- Integration of RBCI in the access scheme → Identification Methods
- Situation Awareness
  - Distribution, Interoperability, flexibility → Information data model proposal
- Demo in AmperLab, Madrid, in September 2010





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Technical insights → End User workshop

November 17, 2010
European Defense Agency, Brussels

Objective

- **Disseminate** WOLF **outcomes** to **operational & technical end-user**
- **Gather feedback** on the proposed vision and technical solutions

Content

- General presentation focusing on **operational** rationales, expectations and **impact** of the proposed solutions
- Dedicated technical workshops on specific matters (flexible, according to the audience)
- Video replay and analysis of September/October demos (SITAWE, Net, Waveform)

Audience

- National representatives
- End users interested in tactical communication : project countries (each entity) + contributing members

WOLF : 1st step in the definition of a future European soldier waveform

- ❑ User needs and scenarios
- ❑ System architecture has been defined
- ❑ Best-suited techniques have been evaluated and compared

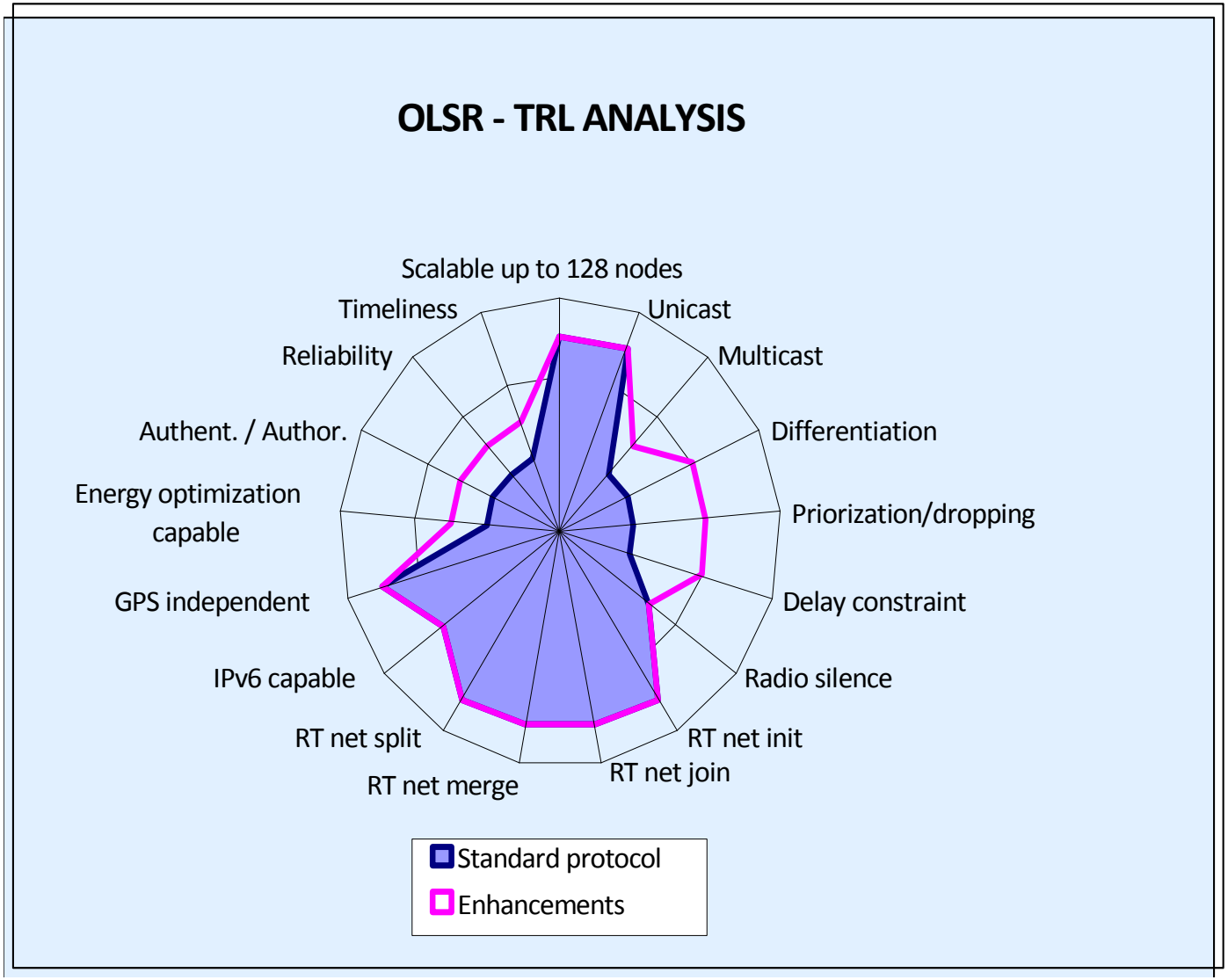
Next step :

- ❑ Investigate additional topics : frequency management, interference avoidance
- ❑ Integrate all the technical concepts (layers) in one testbench
- ❑ Evaluate and tune the mechanisms

➔ **base waveform**

Thank you !

Additional slides


OLSR - TRL ANALYSIS
Scalable up to 128 nodes
Unicast
Multicast
Differentiation
Priorization/dropping
Delay constraint
Radio silence
RT net init
RT net join
RT net merge
RT net split
IPv6 capable
GPS independent
Energy optimization capable
Authent. / Author.
Reliability
Timeliness
Standard protocol
Enhancements